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S190 INTERPRETATION TECHNIQUES DEVELOPMENT AND APPLICATION TO NEW YORK STATE WATER RESOURCES

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Summary

The objective of this investigation is development of interpretation techniques for satellite monitoring of lake eutrophication. Imagery from the S190 and S190B experiments is to be utilized to study eutrophication processes in three lakes important to New York State water resources: Lake Ontario, Conesus Lake and Chautauqua Lake.

During this reporting period the second and third ground and aerial data collection missions were successfully conducted. Unfortunately no concurrent Skylab imagery was obtained during these missions.+ Data reduction commenced on the aerial and ground data of Missions 1-3, as well as the three sets of 1972 aerial imagery of Conesus Lake which are available.

During the next reporting period data missions will be conducted in conjunction with Skylab 3 and 4 data passes. At a minimum one data mission will be conducted during both September and October. Data reduction on the 1972 imagery, and Missions 1-3 of 1973 is expected to be completed.

Discussion

One of the principal questions to be resolved in development of interpretation techniques for satellite measurement of eutrophication indices is whether optical data for large lakes or lake systems can be obtained with sufficient accuracy for these data to be useful as eutrophication indices. We are currently investigating this question for aircraft imagery as part of a program of the International Field Year on the Great Lakes (IFYGL), sponsored by the National Science Foundation.[1]

+ Subsequent to the reporting period the fourth data collection mission was conducted on September 9 and 10 with concurrent Skylab imagery obtained on both dates.

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Preliminary results of the IFYGL investigation indicate that sufficient accuracy can be obtained with careful photometry. The major problem is that, at higher altitudes, up to approximately one-half of the sensor signal is unrelated to lake reflectance, being caused by atmospheric effects.[2] As a result small changes in illumination or atmospheric conditions make analyses of lake data from different times of a seasonal cycle, or from different years, extremely difficult. The illumination and atmospheric problems are being resolved using a shadow calibration technique, and microdensitometry through a specially constructed stereoscope-microdensitometer.[3] Similar analyses are to be applied to the S190 and S190B imagery to determine the impact of such phenomena on satellite measurements of eutrophication.

Data for evaluation of optical eutrophication indices will be taken at intervals of about one month during the period May-November 1973. Surface data will be collected on Conesus and Chautauqua Lakes. During a Skylab pass both lakes are sampled; during other missions only Conesus Lake is sampled. The surface measurements include Secchi disk readings, transmissometer measurements of total attenuation, spectrally filtered measurements of relative irradiance, and water sampling for chlorophyll content. Five sampling stations have been chosen for Conesus Lake, and seven for Chautauqua Lake.

The transmissometer spectral response is that of a Type 5 CdS photocell. The transmissometer is lowered in a horizontal mode, with readings taken at one meter intervals to lake bottom. The irradiance meter spectral response is that of a PIN6D photodetector, coupled to a sandwich of Kodak Infrared Rejection Filters Series No. 305 and No. 301. Irradiance measurements are made at one meter intervals to 10^{-3} surface irradiance through Wratten filters Nos. 92 (red), 93 (green) and 94 (blue). Water samples are obtained from the first meter, and are filtered through Millipore filters for analysis of chlorophyll content.

Imagery is being taken of Conesus, Chautauqua, Canadice and Honeyoe Lakes, as well as those portions of Lake Ontario contained in the flightlines between Olcott, NY and Gold Pt., Ontario, and between Chub Pt., Ontario and Troutberg, NY. Flight altitude is 8000 feet, and resulting image scale is 1:32,000 with 80 mm lenses. Four Hasselblad 500 EL cameras are being utilized with Ektachrome MS2448 and SO242 film types. Each film type is processed with a 5500°K and 13000°K colloidal suspension M type carbon step wedge. Stereo imagery is obtained with approximately 60% overlap.

The first of the seven scheduled monthly surface and aerial data collection missions was successfully completed on 4 and 7 May; the second mission was conducted on 19 June; and the third mission was conducted on 7 August (ground truth) and 13 August (aircraft data). On these data collection missions surface data were obtained for Conesus Lake only. Aerial data were obtained for all lakes, with the exception of Mission 1 on which Lake Ontario was not overflown.

The average Secchi Disk readings on Conesus Lake for Missions 1-3 were 4, 5 and 6.5 meters, respectively. 200 and 400 ml water samples from each of the five lake stations have been filtered, and the filters frozen and stored for analysis of chlorophyll content. In addition, composite water samples from the northern and southern ends of the lake have been stored in Liigol's solution for characterization of algal type. The chlorophyll analyses are expected to be completed by the end of the next (third) reporting period.

Imagery from the first three missions has been processed and has been evaluated as most satisfactory. Densitometric analyses of the imagery have begun, and are expected to be completed by the end of the next reporting period.

Activities During the Next Reporting Period

Data collection missions will be conducted for Skylab 3 and 4. One data mission will be obtained for September and October at a minimum. Chlorophyll analyses will be completed during this period. Densitometric analysis of the aerial data from the 1972 missions, and the first three 1973 missions will be completed.

References

(1) "Optical Properties of Lake Ontario Waters," National Science Foundation Grants GA-32207 and GA-377768.

(2) "Optical Properties of Lake Ontario Waters--First Calendar Year Progress Report," K. R. Piech, Calspan Corporation Report No. KS-5108-M-1, November 1972.

(3) "Thematic Mapping of Flooded Acreage," K. R. Piech and J. E. Walker, Photogrammetric Engineering, November 1972, pp. 1081-1090.